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Karl Thiele

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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/551,321
Filing Date: September 22, 2005
Appellant(s): THIELE, KARL

William S. Francos
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 19 September 2007 appealing from the
Office action mailed 19 April 2007.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The changes are as follows. In referring to the grounds of rejection for claims 1,2,8,9,11-13,15,19,25-27,29,30,32,75,76 and 78, appellant is correct that the intended grounds of rejection are US Patent 6,359,367 to *Sumanaweera et al.*; however, appellant erroneously states that the Office Action cited US Patent 6,625,367, which was not cited at any point of prosecution. Here, it appears that appellant refers to the typographical error in the Office Action, in which *Sumanaweera et al.* was cited as US Patent 6,259,367, as opposed to the correct patent number of

6,359,367. In referring to the grounds of rejection for claims 3-5,14,16-18,20,21,31,33-39,42,43,45-60,63,64,66-74 and 77, appellant correctly identifies the grounds of rejection as being *Ossmann* in view of *Sumanaweera et al.* and *Savord*; however, following this, appellant refers to a 35 U.S.C. 103(a) rejection in view of *Batten et al.* further in view of *Nichols* and further in view of *Pechanek et al.* These three references have not been used as grounds of rejection for any of the claims at any point of prosecution of this case. As such, it appears that this was a typographical error, and that was not intended to be included in the statement of grounds of rejection for claims 3-5,14,16-18,20,21,31,33-39,42,43,45-60,63,64,66-74 and 77.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

2006/0119223	OSSMANN	6-2006
6,359,367	SUMANaweera et al.	3-2002
6,380,766	SAVORD	4-2002
4,771,205	MEQUIO	9-1988

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

Claims 1, 2, 8, 9, 11-13, 15, 19, 25-27, 29, 30, 32, 75, 76, and 78 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Ossmann* (US 20060119223) in view of *Sumanaweera et al.* (US 6259367).

With respect to claim 1, *Ossmann* discloses an apparatus (Fig 4) comprising: a two-dimensional array transducer (item 402) transmitting ultrasonic energy in tissue at a fundamental frequency.

Ossmann does not disclose expressly that the transmitted ultrasonic frequency is transmitted with sufficient power to generate a harmonic of the fundamental frequency in the tissue.

Sumanaweera et al. teaches an ultrasonic transducer array in which the transmitted frequency is the fundamental frequency, which excites a harmonic frequency of the fundamental frequency in the tissue (column 8, line 6 through column 9, line 5).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the Harmonic frequency response of *Sumanaweera et al.* with the transducer array of *Ossmann* for the benefit of eliminating the need for additional contrast agent in creating the ultrasonic image (column 9, lines 48-51).

With respect to claim 2, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Ossmann* discloses that the array transducer

includes a total number of elements of which at least 25% are excited to transmit the ultrasonic energy (Fig 4 and Paragraphs 58-60).

With respect to claim 8, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Sumanaweera et al.* discloses that the array transducer is constructed of materials comprising a single crystal (column 1, lines 48-50). Although *Sumanaweera* does not disclose the use of a single crystal, *Sumanaweera* does disclose the use of PZT, which is a single crystal material.

With respect to claim 9, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Sumanaweera* discloses that the array transducer is constructed of a plurality of piezoelectric elements of a single crystal (column 1, lines 48-50).

With respect to claim 11, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Sumanaweera et al.* discloses that the array transducer transmits the ultrasonic energy at a sufficient power to generate a second harmonic in the tissue having a maximum power level of less than 15 dB from the maximum power level of the fundamental frequency in the tissue (column 8, line 66 through column 9, line 5). *Sumanaweera et al.* does not disclose expressly that the maximum power level of the second harmonic in the tissue is greater than the power level of the fundamental frequency in the tissue; however, it has long been held that it is obvious to optimize the performance of a device by routine experimentation, and if the modifications are within the capabilities of a person of ordinary skill in the art (*In re Aller*, 105 USPQ 233). Therefore, at the time of invention it would have been obvious to a

person of ordinary skill in the art to ensure that the power level of the second harmonic was at least 15 dB below that of the fundamental, as this modification could have been made through routine experimentation within the level of one of ordinary skill in the art.

With respect to claim 12, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Ossmann* discloses that the array transducer has a checkerboard pattern formed by a plurality of elements (Fig 4), each element being used for either transmit or receive.

With respect to claim 13, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Ossmann* discloses that the array transducer has a checkerboard pattern formed by a total number of elements (Fig 4), at least 25% of the total number being used to transmit and a plurality of the elements being used to receive (Fig 4 and Paragraphs 58-60).

With respect to claims 15 and 32, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. Neither *Ossmann* nor *Sumanaweera et al.* disclose expressly that the array transducer is formed by a plurality of elements in an alternating transmit-receive checkerboard pattern. It has long been held that the shifting of the location of components of device would be obvious to a person of ordinary skill in the art (*In re Japikse*, 86 USPQ 70). Therefore, although neither *Ossmann* nor *Sumanaweera et al.* discloses the alternating checkerboard pattern of the transmit and receive elements, it would have been obvious to a person of ordinary skill in the art to rearrange the transmit and receive elements of *Ossmann* and *Sumanaweera et al.* into any desired pattern, including an alternating checkerboard

pattern. Additionally, it has long been held that it would be obvious to a person of ordinary skill in the art to optimize a device, where the modifications require only routine experimentation (*In re Aller*, 105 USPQ 233). Therefore, it would have been obvious to a person of ordinary skill in the art to rearrange the transmit and receive elements of *Ossmann* and *Sumanaweera et al.* into different patterns, including an alternating checkerboard pattern.

With respect to claims 19, 25-27, 29, 30, 75, 76, and 78, the claimed subject matter contained therein is the same as that of claims 1-3, 8, 9, and 11-13; therefore claims 19, 25-27, 29, 30, 75, 76, and 78 are unpatentable over *Ossmann* in view of *Sumanaweera et al.* as in claims 1-3, 8, 9, and 11-13 above.

Claims 3- 5, 14, 16-18, 20, 21, 31, 33-39, 42, 43, 45-60, 63, 64, 66-74 and 77 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Ossmann* in view of *Sumanaweera et al.* and *Savord* (US 6380766).

With respect to claim 3, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Ossmann* discloses transmit beamforming electronics (Paragraph 7).

Neither *Ossmann* nor *Sumanaweera et al.* discloses a high voltage circuit driving the array transducer to transmit the ultrasonic energy.

Savord teaches an ultrasonic transducer array including a high voltage circuit driving the array transducer to transmit ultrasonic energy (Fig 1A).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the high-voltage circuitry of *Savord* with the transducer array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of allowing for a larger range of voltages to be applied to the device (column 1, lines 50-52).

With respect to claim 4, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1.

Neither *Ossmann* nor *Sumanaweera et al.* discloses a high voltage field effect transistor driving the array transducer to transmit the ultrasonic energy.

Savord teaches an ultrasonic transducer array including a high voltage FET driving the array transducer to transmit the ultrasonic energy (column 3, lines 29-32).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the high-voltage circuitry of *Savord* with the transducer array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of allowing for a larger range of voltages to be applied to the device (column 1, lines 50-52).

With respect to claim 5, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1.

Neither *Ossmann* nor *Sumanaweera et al.* discloses means for driving the array transducer with a high voltage to transmit the ultrasonic energy.

Savord teaches an ultrasonic transducer array including means for driving the array transducer with a high voltage to transmit the ultrasonic energy (Fig 1A).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the high-voltage circuitry of *Savord* with the transducer array of

Ossmann as modified by *Sumanaweera et al.* for the benefit of allowing for a larger range of voltages to be applied to the device (column 1, lines 50-52).

With respect to claim 14, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Ossmann* discloses that the array transducer has a checkerboard pattern formed by a total number of elements (Fig 4), at least 25% of the total number of elements being used to transmit the ultrasonic energy.

Neither *Ossmann* nor *Sumanaweera et al.* discloses that high voltage electronics are connected to the transmitting elements or that a plurality of elements are connected to low voltage electronics to receive the generated harmonic.

Savord teaches an ultrasonic transducer array including high voltage electronics connected to the transmit elements, and a plurality of elements are connected to low voltage electronics to receive the generated harmonic (Fig 1A).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the high and low voltage circuitry of *Savord* with the transducer array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of forming the high and low voltage circuits on the same substrate (column 2, lines 18-22).

With respect to claim 16, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1.

Neither *Ossmann* nor *Sumanaweera et al.* discloses expressly a low-voltage circuit and a high voltage circuit driving the array transducer to transmit the ultrasonic energy, the high voltage circuit including a high voltage FET, the low voltage circuit and the high voltage circuit being monolithically formed on a single substrate.

Savord teaches an ultrasonic transducer array including a low-voltage circuit (Fig 1A) and a high voltage circuit driving the array transducer to transmit the ultrasonic energy (Fig 1A), the high voltage circuit including a high voltage FET (column 3, lines 29-32), the low voltage circuit and the high voltage circuit being monolithically formed on a single substrate (column 2, lines 18-22).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the high and low voltage circuitry of *Savord* with the transducer array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of eliminating the need for separate substrates for the low and high voltage circuits (column 7, lines 14-20).

With respect to claim 17, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1.

Neither *Ossmann* nor *Sumanaweera et al.* discloses expressly a low voltage circuit, and a high voltage circuit driving the array transducer to transmit the ultrasonic energy, the low voltage circuit and the high voltage circuit being formed on a single substrate.

Savord teaches an ultrasonic transducer array including a low voltage circuit (Fig 1A), and a high voltage circuit driving the array transducer to transmit the ultrasonic energy (Fig 1A), the low voltage circuit and the high voltage circuit being formed on a single substrate (column 2, lines 18-22).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the high and low voltage circuitry of *Savord* with the transducer

array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of eliminating the need for separate substrates for the low and high voltage circuits (column 7, lines 14-20).

With respect to claim 18, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1.

Neither *Ossmann* nor *Sumanaweera et al.* discloses expressly means for providing a low voltage circuit and a high voltage circuit both formed on the same single substrate, the high voltage circuit for driving the array transducer to transmit the ultrasonic energy.

Savord teaches an ultrasonic transducer array including means for providing a low voltage circuit and a high voltage circuit both formed on the same single substrate (column 2, lines 18-22), the high voltage circuit for driving the array transducer to transmit the ultrasonic energy (Fig 1A).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the high and low voltage circuitry of *Savord* with the transducer array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of eliminating the need for separate substrates for the low and high voltage circuits (column 7, lines 14-20).

With respect to claim 35, *Ossmann* discloses at least some beamforming electronics (Fig 4) generating excitation signals in accordance with the control signals (Fig 4), a two-dimension array transducer (Fig 4). *Sumanaweera et al.* discloses transmitting ultrasonic energy in the tissue at the fundamental frequency with sufficient

power to generate a harmonic frequency of the fundamental frequency in the tissue (column 8, line 6 through column 9, line 5).

Neither *Ossmann* nor *Sumanaweera et al.* discloses expressly a transducer handle positionable near tissue, the handle external to the ultrasound processing equipment producing control signals for ultrasonic imaging, the beamforming electronics being housed in the handle and the 2D array transducer being housed in the handle.

Savord teaches an ultrasonic transducer array that includes a transducer handle positionable near tissue, the handle external to the ultrasound processing equipment producing control signals for ultrasonic imaging, the beamforming electronics being housed in the handle and the 2D array transducer being housed in the handle (column 1, lines 28-33).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the handle of *Savord* with the transducer array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of making the device easier for the user to manipulate.

With respect to claim 53, the combination of *Ossmann*, *Sumanaweera et al.*, and *Savord* discloses an apparatus as in claim 35. *Savord* discloses a communications channel connecting the handle to the ultrasound processing equipment to allow the control signals produced by the electronic processing equipment to be provided to the beamforming electronics in the handle (column 1, lines 29-33).

With respect to claim 54, the combination of *Ossmann*, *Sumanaweera et al.*, and *Savord* discloses an apparatus as in claim 53. *Savord* discloses that the communication

channel is one of the group consisting of a cable and a wireless communications channel (column 1, lines 29-33).

With respect to claim 56, the combination of *Ossmann*, *Sumanaweera et al.*, and *Savord* discloses an apparatus as in claim 55. *Savord* discloses that at least some receive beamforming electronics are housed in the handle and processing the received harmonic (Fig 1A), the receive beamforming electronics connected to the electronics processing equipment by the communication channel to allow the electronic processing equipment (column 1, lines 29-33) to display an ultrasonic image on a display in accordance with the harmonic processed by the receive beamforming electronics (column 1, lines 17-20).

With respect to claims 20, 21, 31, 33, 34, 36-39, 42, 43, 45-52, 55, 57-60, 63, 64, 66-74, and 77, the claimed subject matter contained therein is the same as that of claims 1-5, 8, 9, 11-18, 35, 53, and 54; therefore, claims 20, 21, 31, 33, 34, 36-39, 42, 43, 45-52, 55, 57-60, 63, 64, 66-74, and 77 are unpatentable over *Ossmann* in view of *Sumanaweera* in view of *Savord* as in claims 1-5, 8, 9, 11-18, 35, 53, and 54 above.

Claims 6, 7, 10, 22-24, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Ossmann* in view of *Sumanaweera et al.* and *Mequio* (US 4771205).

With respect to claim 6, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Ossmann* discloses that the array transducer includes a plurality of piezoelectric elements forming the array transducer (Fig 4).

Neither *Ossmann* nor *Sumanaweera et al.* discloses expressly a high impedance backing for the piezoelectric element.

Mequio teaches an ultrasonic transducer including a high impedance backing for the piezoelectric element (column 1, lines 37-50).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the high-impedance backing of *Mequio* with the ultrasonic transducer array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of ensuring sufficient rigidity to ensure zero deformation (column 1, lines 37-50).

With respect to claim 7, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1. *Ossmann* discloses that the array transducer includes a plurality of piezoelectric elements forming the array transducer (Fig 4).

Neither *Ossmann* nor *Sumanaweera et al.* discloses expressly means for providing a high impedance backing for the piezoelectric elements.

Mequio teaches an ultrasonic transducer including means for providing a high impedance backing for the piezoelectric elements (column 1, lines 37-50).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the high-impedance backing of *Mequio* with the ultrasonic transducer array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of ensuring sufficient rigidity to ensure zero deformation (column 1, lines 37-50).

With respect to claim 10, the combination of *Ossmann* and *Sumanaweera et al.* discloses an apparatus as in claim 1.

Neither *Ossmann* nor *Sumanaweera et al.* discloses expressly that the array transducer transmits ultrasound energy with a waveform having a bandwidth BW greater than or equal to 60% of the fundamental frequency, where $BW = (f_B - f_A)$, f_B is a higher frequency than the fundamental frequency at a power level 6 dB lower than at the fundamental frequency, f_A is a lower frequency than the fundamental frequency at a power level 6 dB lower than the fundamental frequency.

Mequio teaches an ultrasonic transducer in which the array transducer transmits ultrasound energy with a waveform having a bandwidth BW greater than or equal to 60% of the fundamental frequency, where $BW = (f_B - f_A)$, f_B is a higher frequency than the fundamental frequency at a power level 6 dB lower than at the fundamental frequency, f_A is a lower frequency than the fundamental frequency at a power level 6 dB lower than the fundamental frequency (column 4, lines 10-14 and 21-25).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the large bandwidth of *Mequio* with the ultrasonic transducer array of *Ossmann* as modified by *Sumanaweera et al.* for the benefit of increasing the sensitivity of the device (column 1, lines 22-25).

With respect to claims 22-24 and 28, the claimed subject matter contained therein is the same as that of claims 6, 7, and 10; therefore, claims 22-24 and 28 are unpatentable over *Ossmann* in view of *Sumanaweera* in view of *Mequio* as in claims 6, 7, and 10 above.

Claims 40, 41, 44, 61, 62, and 65 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Ossmann* in view of *Sumanaweera et al.*, *Savord*, and *Mequio*.

With respect to claims 40, 41, 44, 61, 62, and 65, the claimed subject matter contained therein is the same as that of claims 6, 7, 35, and 55; therefore, claims 40, 41, 44, 61, 62, and 65 are unpatentable over *Ossmann* in view of *Sumanaweera et al.* in view of *Savord* in view of *Mequio* as in claims 6, 7, 35, and 55 above.

(10) Response to Argument

Appellant argues that *Ossmann* does not disclose transmitting ultrasonic energy in tissue at a fundamental frequency. However, *Ossmann* clearly transmits ultrasonic energy in tissue (Paragraph 18). With regards to the limitation "at a fundamental frequency," any frequency can be a "fundamental frequency" as claimed. A fundamental frequency is simply the lowest frequency in a harmonic series. The claim language requires that ultrasonic energy is transmitted into tissue at a fundamental frequency and of sufficient power to generate a harmonic of the fundamental frequency in the tissue. Here, any frequency can be a fundamental frequency, and as a fundamental frequency, its harmonics then become integer multiples of that frequency. Appellant argues that *Sumanaweera et al.* does not disclose that the ultrasonic energy is transmitted into tissue at a fundamental frequency at a fundamental frequency and of sufficient power to generate a harmonic of the fundamental frequency in the tissue. However, *Sumanaweera et al.* states "In addition to receiving signals at the fundamental frequency (i.e., the same frequency as that transmitted), the nonlinear characteristics of tissue or optional contrast agents also produce responses of harmonic frequencies"

(column 8, line 66 through column 9, lines 3). So, *Sumanaweera et al.* transmits ultrasonic energy into the tissue at a fundamental frequency, and as a result harmonics of the fundamental are generated in the tissue. *Sumanaweera et al.* states that they are generated as a non-linear effect of the tissue, and does not make mention of the generation of harmonics being due to the sufficiency of the power. However, as harmonics of the fundamental are generated, the applied ultrasonic energy must be of sufficient energy to generate those harmonics. In addition, the claim language "transmitting ultrasonic energy in tissue at a fundamental frequency and of sufficient power to generate a harmonic of the fundamental frequency in the tissue" is functional language that does not impart further structure on the device. Appellant argues that the rationale for the rejections of claims 75, 76, and 78 is improper, as neither *Ossmann* nor *Sumanaweera et al.* explicitly disclose the claimed checkerboard pattern. However, the term "checkerboard pattern" can be interpreted to be any of many different patterns. As stated in the Office Action from 19 April 2007, neither *Ossmann* nor *Sumanaweera et al.* explicitly disclose the claimed checkerboard pattern; however, it would still be obvious to rearrange the various transmit and receive elements into any desired arrangement, as it has been held that the shifting of the location of components of a device would be obvious to a person of ordinary skill in the art (*In re Japikse*, 86 USPQ 70). Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to rearrange the various transmit and receive elements of *Ossmann* into any desired pattern, including any one of the many patterns that could be described as checkerboard.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

DJR 12/12/07

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